ESC201T: Introduction to Electronics

HW -10 **Date: 19.11.2020**

Q.1 Convert the following numbers into the number system indicated:

a. $(1010.011)_2$ to decimal

b. $(FA)_{16}$ to decimal

c. $(101110101101)_2$ into hexadecimal

d. $(FA)_{16}$ to binary

Q.2 Convert the decimal number 27.25 into a binary number.

Q.3 What is the largest decimal number that you can represent using 8bits? How many bits are required to represent decimal numbers less than or equal to 10^6?

Q.4 Determine the number system in which the following arithmetic operations have been carried out. Give justifications for your answer

a. 24+17=40

b. 22 x 5 = 132

Q.5 Obtain 1's and 2's complement of the following binary numbers

a. 10000000

b. 10101010

c. 01110101

d. 10011100

Q.6a What is the minimum number of bits required to represent -32 in 2's complement form?

b. 11011111 is a number in 2's complement. Is it positive or negative? What is its magnitude?

Q.7 Carry out the following four operations using 8bit 2's complement representation:

$\pm 24 \pm 32$

Verify that operations have been properly carried out.

Q.8 Show that the Boolean expression $x + \bar{x}.y$ is equivalent to $x + y$ using basic postulates and theorems of Boolean algebra

Q.9 Reduce the following expressions to a minimum number of literals.

a. $f = (x + \bar{y} + \bar{z}).(\bar{y} + \bar{z})$

b. $f = (x + y).(\bar{y} + \bar{x})$

c. $f = ABCD + \bar{A}BD + AB\bar{C}D$

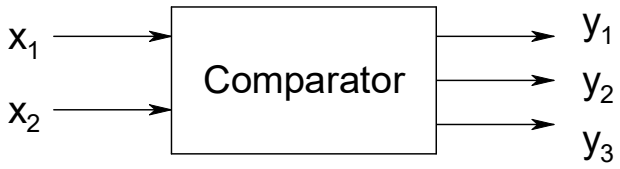
Q.10 Obtain the truth table for the following function: (x.y+z)(y+x.z) and write it as sum of products (SOP) and product of sums (POS).

Q.11 Implement an 8 input OR gate using only 2 input AND and 2 input OR gates.

Q.12 Show that you can implement 2 input AND, 2 input OR and NOT gates using only 2 input NAND gates. Similarly show that you can implement 2 input AND, 2 input OR and NOT gates using only 2 input NOR gates.

Q.13 Implement a 2-input exclusive OR gate with only 2 input NAND gates .

Q.14 Figure below shows a block diagram of a comparator. From the description given , obtain first the truth table for outputs y_1 , y_2 and y_3, then the Boolean expression and finally the gate netlist. Both inputs are 1-bit.



y_1 is 1 if and only if $x_1 > x_2$

y_2 is 1 if and only if $x_1 = x_2$

y_3 is 1 if and only if $x_1 < x_2$

Q.15 Simplify the following 4-variable functions into sum-of-products form using K-map.

a. $\sum(1,5,6,7,14)$

b. $\sum(0,4,6,8)$

c. $\sum(0,1,4,6,8,9,14)$

d. $\sum(1,4,7,11,13,14)$

Q.16 Simplify the following 4-variable functions into product-of-sums form using K-map

a. $\Pi\ (1,3,5,7,13,15)$

b. $\Pi\ (1,3,6,9,11,12,14)$

c. $\Pi\ (1,3,5,7,9,11,12,13,14,15,)$ d. $\Pi\ (0,1,3,4,5,7,12,13,15)$

Q.17 Simplify the following expressions into sum-of-products form using the don't care conditions (d) into account.

a. $F(A,B,C,D)=\sum(4,5,7,12,13,14)$, $d(A,B,C,D)=\sum(1,9,11,15)$

b. $F(A,B,C,D)=\sum(1,2,12,13,14)$, $d(A,B,C,D)=\sum(8,9,10,11)$

Q.18 For the Boolean expression given below, implement it using two levels of logic first as AND-OR and then as OR-AND.

$$F(a,b,c,d)=(ab+cd)(\overline{a}b+\overline{c}d+a\overline{c})$$

Q.19 Implement the following expression using only 2-input NAND gates and then repeat the problem with only 2 input NOR gates.

$$F(a,b,c,d)=ab+\overline{a}bc+\overline{a}\overline{b}\overline{c}d$$

Q.20 Design a combinational circuit with 3 inputs and 1 output

(a) The output is 1 when the binary value of the inputs is less than 3. The output is 0 otherwise

(b) The output is 1 when the binary value of inputs is an odd number.

Q.21 Design a half subtractor circuit with inputs x and y and outputs Diff. and B_{out}. The circuit subtracts the bits x-y and places the result in Diff. and borrow in $B_{out.}$